Eighty-eight presents were announced as having been received since the last meeting, including, amongst others :—

Besançon Observatory, Bulletin Astronomique, Bulletin Chronométrique, Bulletin Météorologique, etc., presented by the Observatory.

Astrographic Chart of the heavens; 20 charts presented by the Royal Observatory, Greenwich; 47 charts from the Paris, Algiers, and Toulouse Observatories, presented by the French Minister of Public Instruction.

Determinations of Personal Equation depending on Magnitude, made with the Transit Circles and the Heliometer at the Royal Observatory, Cape of Good Hope. By Sir David Gill, K.C.B., F.R.S., and S. S. Hough, F.R.S., H.M. Astronomer at the Cape.

The observations here discussed were planned at the time when a discussion had arisen between Mr Hinks and Dr Cohn * as to the existence of personality depending on magnitude in transit observations made by the Repsold travelling wire method.

The question at issue is so important in connection with the future of meridian observation, that it appeared desirable to devote a considerable amount of time and labour to its settlement. The position of a bright star relative to two symmetrically situated faint stars of equal magnitude can be determined by means of heliometer observations with great precision and absolute freedom from personality. With the modern heliometer the images of the brighter star can be reduced by means of screens to similarity with the images of the fainter stars. Even if we grant that there may be a personality depending on a residual apparent difference of magnitude between the image of the star whose brightness is reduced and that of the other star under measurement, it is impossible to imagine that the observer can be affected by any difference of personality in the measurement of distance of two pairs of stars where one component of one pair precedes and the other follows the star whose magnitude has been reduced by the screen, because the two conditions of measurement are exactly similar.

Farther, if the measures of both distances are made simultaneously (*i.e.* in the order a, b, b, a), the instantaneous scale-value must be the same for both. Then, if we suppose the position-angles also to be measured, we can introduce both the scale-value and the index error of the position-circle as unknown quantities, and determine the R.A. and Dec. of the brighter star relative to the fainter stars—free from all personality. And if the differences of declination are either very small or accurately determined, we

* *Monthly Notices*, lxvi. p. 481, and *Ast. Nach.*, No. 4119.

determine directly the R.A. of the bright star relative to the mean R.A. of the faint stars, free from personal and other systematic error.

We have in our experience at the Cape many instances of this freedom from personality in heliometer observations, of which a very good instance will be found in the *Annals of the Cape Observatory*, vol. viii. part 2, pp. 73B–81B, in connection with the determination of the parallax of β Crucis by Gill and Finlay. There we have observations of the distances of two stars of $6\frac{1}{2}$ and 7 magnitude in almost exactly opposite directions from β Crucis, and situated at distances of $2812''$ and $3434''$ respectively from it. Gill measured these distances on seventeen nights, and Finlay on fifteen nights. In forming the equations of condition for determining the parallax, the difference of the two distances for 1890 was assumed to be $622''\cdot050 + x_g$ for Gill, and $622''\cdot050 + x_f$ for Finlay. The simultaneous solution of the equations gave

$$x_g = -0''\cdot001 \pm 0''\cdot019$$
$$x_f = -0\ \cdot021 \pm 0\ \cdot023$$

and the probable error of the single observation $\pm 0''\cdot077$.

But if we regarded $x_g = x_f$, the probable error of the single observation became $\pm 0''\cdot074$.

The latter solution is thus the better of the two, proving that there is no sensible systematic difference in the determination of the position of β Crucis by the two observers.

About the time that the after-mentioned operations were commenced, the completion of the current Catalogue with the old Transit Circle left the observers free to make simultaneous observations with the latter, and a verification of their personal equation depending on magnitude, derived some two years previously by the screen method, was thus rendered as convenient as it was desirable.

The groups of stars selected consisted of three stars approximately on the arc of a great circle and, as nearly as could be chosen, equi-spaced. The middle star was on the average of about $3\frac{1}{2}$ magnitude, and the preceding and following stars on the average about $8\frac{1}{2}$ magnitude. The difference of R.A. was always large enough to allow of all three stars being observed without undue haste on the same night, while the distances were restricted by the limitation that they must fall within the range which could be measured by the heliometer, viz. about 2°.

The transit observations involved the transit of each of the three stars in succession, so that their differences of R.A. could be derived independently of clock error or other instrumental adjustments.

The heliometer measurements consisted in the measurements of distance and position-angle of the bright star from each of the fainter ones of the group. From these observations the position of the bright star relatively to the two fainter ones can be derived

independently of the instantaneous scale-value or index correction to the position-circle or other equatorial adjustments of the heliometer.

The adopted magnitudes of the stars have been taken where possible from the Harvard Photometry. For stars not contained therein, the magnitudes are derived from estimates made by the Transit Circle observers, using, as standards, stars whose magnitudes have been determined at Harvard.

The following is a list of the groups observed, numbered consecutively in order of R.A. The initials *a*, *b* are used to distinguish the preceding and following pairs of the group. It should be noticed that in some cases the same bright star has been used in more than one group. For simplicity of reduction, however, such groups have been treated as if they were independent.

TABLE I.

List of Magnitude Personal Equation Stars.

Group No.	Name. B.D. No.	Mag.	R.A. 1906·0. h m s	Dec. 1906·0. ° ′ ″
1 *a*	−3°, 3882	8·7	16 4 41·01	− 3 17 56·17
	δ Ophiuchi	3·1	16 9 25·10	− 3 27 9·56
b	−3°, 3915	8·2	16 12 48·75	− 3 48 14·44
2 *a*	−25°, 5787	8·7	16 18 2·23	−26 3 4·54
	α Scorpii	1·3	16 23 38·51	−26 13 25·74
b	−26°, 5678	8·5	16 29 28·55	−26 16 58·14
3 *a*	−10°, 4383	8·3	16 40 10·37	−10 29 26·91
	20 Ophiuchi	4·7	16 44 37·97	−10 37 1·73
b	−10°, 4403	8·3	16 48 22·13	−10 35 56·57
4 *a*	−15°, 4439	8·7	16 58 40·38	−16 3 37·98
	η Ophiuchi	2·6	17 4 59·14	−15 36 32·12
b	−15°, 4502	6·7	17 10 53·66	−15 7 6·94
5 *a*	+12°, 3234	6·7	17 25 59·98	+11 59 45·78
	α Ophiuchi	2·1	17 30 34·24	+12 37 40·72
b	+13°, 3421	6·3	17 34 38·73	+13 22 51·73
6 *a*	−9°, 4616	8·9	17 46 49·71	− 9 57 13·63
	ν Ophiuchi	3·5	17 53 51·07	− 9 45 44·99
b	−9°, 4646	8·6	18 0 0·97	− 9 35 0·23
7 *a*	−3°, 4255	9·5	18 8 38·83	− 3 0 44·65
	η Serpentis	3·5	18 16 26·72	− 2 55 24·93
b	−2°, 4638	8·3	18 24 20·45	− 2 50 0·69

TABLE I.—*continued.*

Group No.	Name. B.D. No.	Mag.	R.A. 1906·0.	Dec.
			h m s	° ′ ″
8 *a*	−4°, 4557	9·2	18 37 23·90	− 4 54 0·99
	6 Scuti	4·5	18 42 11·22	− 4 50 56·03
b	−4°, 4603	9·2	18 47 50·28	− 4 50 38·87
9 *a*	−5°, 4835	9·1	18 55 25·09	− 5 30 7·85
	λ Aquilæ	3·5	19 1 15·63	− 5 1 25·81
b	−4°, 4719	8·6	19 7 23·99	− 4 37 11·97
10 *a*	−5°, 4845	8·3	18 57 50·51	− 5 40 17·73
	λ Aquilæ	3·5	19 1 15·63	− 5 1 25·81
b	−4°, 4712	8·7	19 5 15·79	− 4 12 10·57
11 *a*	+2°, 3856	7·8	19 15 55·70	+ 2 45 43·22
	δ Aquilæ	3·4	19 20 45·54	+ 2 55 36·96
b	+3°, 4043	6·4	19 25 50·94	+ 3 14 51·72
12 *a*	+3°, 3990	8·8	19 17 42·36	+ 3 9 33·36
	δ Aquilæ	3·4	19 20 45·54	+ 2 55 36·96
b	+2°, 3892	5·9	19 23 37·64	+ 2 44 18·32
13 *a*	+8°, 4198	8·4	19 39 50·81	+ 8 51 55·66
	α Aquilæ	0·8	19 46 11·83	+ 8 37 10·64
b	+8°, 4275	8·0	19 52 21·75	+ 8 11 48·34
14 *a*	+8°, 4227	9·0	19 44 39·25	+ 8 22 10·96
	α Aquilæ	0·8	19 46 11·83	+ 8 37 10·64
b	+8°, 4247	8·2	19 47 57·91	+ 8 53 20·02
15 *a*	−0°, 3911	8·6	20 2 1·01	− 0 24 11·00
	θ Aquilæ	3·4	20 6 27·31	− 1 6 2·36
b	−1°, 3935	7·5	20 11 34·11	− 1 47 16·90
16 *a*	−1°, 3902	8·0	20 4 31·69	− 1 32 57·82
	θ Aquilæ	3·4	20 6 27·31	− 1 6 2·36
b	−0°, 3942	7·5	20 8 14·67	− 0 36 47·98
17 *a*	−18°, 5663	8·5	20 18 10·75	−18 31 1·02
	π Capricorni	5·1	20 21 56·51	−18 31 12·58
b	−18°, 5705	8·3	20 26 2·67	−18 24 0·52
18 *a*	−5°, 5349	7·9	20 37 31·64	− 5 38 0·18
	3 Aquarii	4·5	20 42 46·70	− 5 22 20·10
b	−5°, 5402	8·5	20 47 21·78	− 5 3 22·24

TABLE I.—*continued.*

Group No.	Name. B.D. No.	Mag.	R.A. 1906·0. h m s	Dec. 1906·0. ° ′ ″
19 *a*	−5°, 5368	7·7	20 38 58·33	− 5 55 44·88
	3 Aquarii	4·5	20 42 46·70	− 5 22 20·10
b	−5°, 5395	8·1	20 45 45·03	− 5 8 30·84
20 *a*	−17°, 6140	8·3	20 55 10·77	−17 14 39·95
	θ Capricorni	4·1	21 0 39·87	−17 36 24·39
b	−18°, 5886	8·3	21 8 31·41	−17 57 9·39
21 *a*	−17°, 6167	7·6	20 59 34·81	−17 32 13·51
	θ Capricorni	4·1	21 0 39·87	−17 36 24·39
b	−18°, 5862	6·0	21 2 27·97	−17 49 58·95
22 *a*	−6°, 5757	8·3	21 21 37·93	− 6 24 29·01
	β Aquarii	3·0	21 26 36·68	− 5 59 6·11
b	−5°, 5592	7·7	21 31 36·79	− 5 38 22·65
23 *a*	−6°, 5761	8·9	21 23 5·00	− 6 1 43·73
	β Aquarii	3·0	21 26 36·68	− 5 59 6·11
b	−6°, 5782	8·8	21 28 57·14	− 5 53 47·51
24 *a*	+9°, 4871	8·9	21 35 27·07	+ 9 33 42·93
	ε Pegasi	2·7	21 39 34·15	+ 9 26 37·45
b	+9°, 4899	8·7	21 43 23·01	+ 9 24 36·95
25 *a*	+5°, 4947	7·7	22 0 58·56	+ 5 30 32·09
	θ Pegasi	3·7	22 5 27·48	+ 5 44 6·65
b	+5°, 4982	8·5	22 10 51·38	+ 6 10 29·60
26 *a*	−11°, 5823	8·0	22 19 31·52	−11 37 58·19
	σ Aquarii	4·8	22 25 40·44	−11 9 32·79
b	−11°, 5875	8·9	22 31 41·51	−10 46 31·29
27 *a*	−14°, 6337	8·6	22 39 59·06	−14 7 52·55
	τ Aquarii	4·4	22 44 36·92	−14 5 21·01
b	−14°, 6367	8·9	22 50 25·35	−14 14 28·93
28 *a*	+15°, 4737	9·0	22 54 12·54	+15 16 43·73
	α Pegasi	2·6	23 0 4·66	+14 41 57·77
b	+13°, 5059	7·8	23 5 16·14	+13 55 7·89
29 *a*	−20°, 6568	8·7	23 11 40·04	−20 28 29·33
	b′ Aquarii	4·3	23 18 2·08	−20 36 49·97
b	−20°, 6606	8·8	23 25 9·70	−20 41 22·09

TABLE I.—*continued.*

Group No.	Name. B.D. No.	Mag.	R.A. 1906·0. h m s	Dec. 1906·0. ° ′ ″
30 *a*	−15°, 6462	8·5	23 32 32·46	−14 44 13·17
	ω^2 Aquarii	4·5	23 37 50·88	−15 3 53·03
b	−15°, 6500	8·9	23 43 44·24	−15 22 50·19
31 *a*	+5°, 5230	8·4	23 48 19·79	+ 6 10 34·47
	ω Piscium	4·0	23 54 29·03	+ 6 20 34·66
b	+6°, 5242	7·8	0 2 15·15	+ 6 21 10·58
32 *a*	−9°, 23	8·5	0 7 33·83	− 9 13 56·19
	i Ceti	3·7	0 14 38·33	− 9 20 41·89
b	−9°, 79	8·0	0 22 33·65	− 9 10 40·25
33 *a*	−18°, 98	8·8	0 31 33·79	−18 7 41·30
	β Ceti	2·3	0 38 52·31	−18 30 8·60
b	−19°, 133	8·6	0 45 59·89	−19 1 2·22

The results of the observations are contained in the following Tables II. and III.

The transit observations have been made by seven different observers, two using the old Transit Circle and recording the times of transit over fixed wires in the usual manner by means of a chronograph, and the remaining five observing with the new reversible Transit Circle by means of a travelling wire guided by hand, and automatically recording on the chronograph the instants when the wire reached certain fixed positions. The results have been referred to the equinox 1906·0 by the application of the usual star-corrections. Table II. contains the observed differences of R.A. derived by the different observers after application of these corrections, the suffixes indicating the number of separate observations involved in each result.

The heliometer measures have been made by two observers, Messrs Whittingdale and Baldwin. The results quoted in Table III. are the mean results from all the measures of each pair. They have been corrected for refraction, but, except in a few cases, no corrections for aberration or nutation have been applied, as these quantities will be practically eliminated simultaneously with the instrumental scale-constant and index correction to the position-circle

TABLE II.

Observed Differences of Right Ascensions.

Epoch 1906·0.

Instrument.	8-inch Transit.		Reversible Transit Circle.				
Observer.	Power.	Pead.	Wilkin.	Jeffries.	Mullis.	Wood.	Jackson.
	m s	m s	m s	m s	m s	m s	m s
1 *a*	...	4 44·075$_2$	4 44·135$_1$	...	...	...	...
b	...	3 23·692$_2$	3 23·597$_1$	...	...	...	...
2 *a*	...	5 36·185$_2$	5 36·230$_2$	...	5 36·225$_1$	...	...
b	...	5 50·015$_2$	5 49·970$_2$	...	5 49·935$_1$	...	...
3 *a*	...	4 27·514$_3$	4 27·564$_1$	...	...	4 27·524$_1$	4 27·614$_1$
b	...	3 44·178$_3$	3 44·141$_1$	...	...	3 44·151$_1$	3 44·081$_1$
4 *a*	6 18·694$_2$	6 18·647$_3$	6 18·679$_2$	...	6 18·709$_2$	...	6 18·724$_1$
b	5 54·470$_2$	5 54·557$_3$	5 54·512$_2$	...	5 54·472$_2$	...	5 54·465$_1$
5 *a*	4 34·146$_2$	4 34·168$_4$	4 34·201$_2$	...	4 34·279$_1$	4 34·259$_1$	4 34·269$_1$
b	4 4·520$_2$	4 4·508$_4$	4 4·485$_2$	...	4 4·455$_1$	4 4·455$_1$	4 4·435$_1$
6 *a*	7 1·217$_1$	7 1·197$_3$	7 1·270$_2$	7 1·247$_1$	7 1·242$_1$	7 1·310$_1$	7 1·310$_1$
b	6 9·909$_1$	6 9·945$_3$	6 9·873$_2$	6 9·899$_1$	6 9·917$_1$	6 9·848$_1$	6 9·848$_1$
7 *a*	...	7 47·742$_5$	7 47·811$_2$	7 47·762$_1$	7 47·829$_1$	...	7 47·848$_1$
b	...	7 53·716$_5$	7 53·691$_2$	7 53·722$_1$	7 53·670$_1$	...	7 53·619$_1$
8 *a*	4 47·277$_1$	4 47·196$_4$	4 47·281$_2$	...	4 47·263$_1$	...	4 47·312$_1$
b	5 39·054$_1$	5 39·088$_4$	5 39·048$_2$	...	5 39·010$_1$	...	5 38·979$_1$
9 *a*	5 50·477$_3$	5 50·447$_6$	5 50·507$_4$	5 50·526$_2$	5 50·564$_1$	...	5 50·489$_2$
b	6 8·389$_3$	6 8·416$_6$	6 8·356$_4$	6 8·351$_2$	6 8·313$_1$	...	6 8·319$_2$
10 *a*	3 25·144$_4$	3 25·122$_3$	...	...	...	...	...
b	4 0·112$_4$	4 0·167$_3$	...	...	...	...	...
11 *a*	4 49·789$_4$	4 49·739$_7$	4 49·819$_3$	4 49·823$_2$	4 49·795$_3$	4 49·846$_1$	4 49·834$_3$
b	5 5·322$_4$	5 5·403$_7$	5 5·356$_3$	5 5·333$_2$	5 5·365$_3$	5 5·356$_1$	5 5·338$_3$
12 *a*	3 3·194$_2$	3 3·162$_5$	...	...	...	...	...
b	2 52·048$_2$	2 52·099$_5$	...	...	...	...	...
13 *a*	6 20·946$_6$	6 20·913$_5$	6 20·956$_1$	6 20·946$_1$	6 21·017$_2$	6 21·014$_2$	6 20·972$_1$
b	6 9·867$_6$	6 9·870$_5$	6 9·876$_1$	6 9·785$_1$	6 9·776$_2$	6 9·803$_2$	6 9·893$_1$
14 *a*	1 32·548$_4$	1 32·537$_5$	...	...	...	...	...
b	1 46·042$_4$	1 46·082$_5$	...	...	...	...	...
15 *a*	4 26·223$_4$	4 26·251$_4$	4 26·284$_1$	4 26·251$_3$	4 26·236$_2$	4 26·279$_1$	4 26·298$_3$
b	5 6·768$_4$	5 6·759$_4$	5 6·761$_1$	5 6·775$_3$	5 6·743$_2$	5 6·758$_1$	5 6·739$_3$
16 *a*	1 55·632$_4$	1 55·639$_4$	...	..	...	...	...
b	1 47·332$_4$	1 47·352$_4$	...	...	...	...	...

TABLE II.—*continued.*

Instrument.	8-inch Transit.		Reversible Transit Circle.				
Observer.	Power.	Pead.	Wilkin.	Jeffries.	Mullis.	Wood.	Jackson.
	m s	m s	m s	m s	m s	m s	m s
17 *a*	3 45·821$_4$	3 45·787$_3$	3 45·816$_1$	3 45·761$_2$	3 45·812$_2$	3 45·777$_2$	3 45·781$_3$
b	4 6·091$_4$	4 6·104$_3$	4 6·086$_1$	4 6·141$_2$	4 6·102$_2$	4 6·148$_2$	4 6·141$_3$
18 *a*	5 15·029$_4$	5 15·023$_3$	...	5 15·023$_4$	5 15·047$_3$	5 15·058$_3$	5 15·045$_2$
b	4 35·123$_4$	4 35·122$_3$	...	4 35·097$_4$	4 35·059$_3$	4 35·076$_3$	4 35·087$_2$
19 *a*	3 48·363$_4$	3 48·357$_3$	...	...	...	...	...
b	2 58·309$_4$	2 58·338$_3$	...	...	...	...	...
20 *a*	6 29·125$_1$	6 29·129$_1$	6 29·078$_1$	6 29·183$_2$	6 29·111$_3$	6 29·116$_5$	6 29·149$_2$
b	7 51·533$_1$	7 51·524$_1$	7 51·522$_1$	7 51·506$_2$	7 51·510$_3$	7 51·517$_5$	7 51·482$_2$
21 *a*	1 5·031$_4$	1 5·023$_3$	...	...	...	...	...
b	1 48·093$_4$	1 48·087$_3$	...	...	...	...	...
22 *a*	4 58·727$_5$	4 58·755$_1$	4 58·725$_1$	4 58·752$_4$	4 58·745$_2$	4 58·746$_6$	4 58·757$_3$
b	5 0·103$_5$	5 0·077$_1$	5 0·127$_1$	5 0·124$_4$	5 0·063$_2$	5 0·124$_6$	5 0·110$_3$
23 *a*	3 31·661$_5$	3 31·578$_1$	...	...	...	...	...
b	2 20·476$_5$	2 20·472$_1$	...	...	...	...	...
24 *a*	4 7·040$_4$	4 6·987$_1$	4 7·017$_1$	4 7·024$_3$	4 7·077$_2$	4 7·086$_3$	4 7·044$_2$
b	3 48·891$_4$	3 48·918$_1$	3 48·858$_1$	3 48·872$_3$	3 48·843$_2$	3 48·844$_3$	3 48·865$_2$
25 *a*	4 28·907$_3$	4 28·878$_1$	4 28·858$_2$	4 28·907$_3$	4 28·870$_3$	4 28·886$_4$	4 28·907$_4$
b	5 23·885$_3$	5 23·973$_1$	5 23·913$_2$	5 23·897$_3$	5 23·925$_3$	5 23·918$_4$	5 23·894$_4$
26 *a*	6 8·872$_2$	...	6 8·880$_1$	6 8·901$_2$	6 8·903$_2$	6 8·918$_3$	6 8·923$_3$
b	6 1·094$_2$	...	6 1·012$_1$	6 1·079$_2$	6 1·040$_2$	6 1·037$_3$	6 1·078$_3$
27 *a*	4 37·844$_1$	4 37·796$_1$	4 37·875$_1$	4 37·846$_1$	4 37·824$_1$	4 37·875$_2$	4 37·849$_3$
b	5 48·458$_1$	5 48·531$_1$	5 48·443$_1$	5 48·437$_1$	5 48·468$_1$	5 48·434$_2$	5 48·390$_3$
28 *a*	5 52·140$_2$	...	5 52·109$_2$	5 52·164$_1$	5 52·072$_2$	5 52·123$_3$	...
b	5 11·474$_2$	...	5 11·473$_2$	5 11·478$_1$	5 11·506$_2$	5 11·453$_3$	...
29 *a*	6 22·070$_1$	6 21·909$_1$	6 22·031$_2$	6 21·984$_1$	6 22·049$_3$	6 22·021$_3$	6 22·004$_3$
b	7 7·631$_1$	7 7·670$_1$	7 7·618$_2$	7 7·630$_1$	7 7·603$_3$	7 7·589$_3$	7 7·637$_3$
30 *a*	5 18·536$_1$	5 18·395$_1$	5 18·458$_2$	5 18·393$_1$	5 18·426$_3$	5 18·480$_3$	5 18·395$_3$
b	5 53·125$_1$	5 53·394$_1$	5 53·313$_2$	5 53·375$_1$	5 53·339$_3$	5 53·309$_3$	5 53·345$_3$
31 *a*	6 9·257$_1$	6 9·106$_1$	6 9·236$_2$	6 9·266$_1$	6 9·234$_3$	6 9·258$_3$	6 9·241$_3$
b	7 46·215$_1$	7 46·213$_1$	7 46·099$_2$	7 46·099$_1$	7 46·191$_3$	7 46·094$_3$	7 46·112$_3$
32 *a*	7 4·385$_1$	...	7 4·528$_1$	...	7 4·506$_3$	7 4·490$_3$	7 4·517$_2$
b	7 55·441$_1$	...	7 55·280$_1$	...	7 55·295$_3$	7 55·310$_3$	7 55·331$_2$
33 *a*	...	...	7 18·515$_2$	7 18·576$_1$	7 18·537$_3$	7 18·559$_3$	7 18·573$_1$
b	...	...	7 7·585$_2$	7 7·586$_1$	7 7·642$_3$	7 7·572$_3$	7 7·595$_1$

TABLE III.

Table of Instrumental Distances and Position-Angles observed with the Heliometer.

Group.	No. of Observation. D.	P.A.	*a.* Distance.	*a.* Position-Angle.	*b.* Distance.	*b.* Position-Angle.
			"	° ′ "	"	° ′ "
1	3	2	4289·419	277 59 48	3299·816	293 7 31
2	3	1	4569·911	278 23 13	4711·909	273 9 33
3	2	1	3971·132	277 9 18	3304·070	269 26 39
4	3	2	5702·217	254 0 19	5422·158	251 34 51
5	2	2	4617·319	241 3 32	4483·717	233 23 13
6	3	1	6262·879	264 14 24	5506·352	263 49 53
7	3	1	7015·268	267 58 24	7102·951	267 57 26
8	3	1	4297·166	268 7 12	5067·526	271 44 11
9	3	2	5510·700	252 22 22	5693·633	255 46 51
10	3	3	3849·927	233 18 15	4650·005	231 6 24
11	4	2	4381·633	262 47 1	4716·047	256 23 16
12	3	2	2868·977	287 32 12	2665·012	285 18 48
13	3	2	5716·171	279 28 13	5693·492	286 4 18
14	3	3	1642·636	237 21 33	1845·856	238 55 22
15	3	3	4717·547	302 44 44	5222·509	298 51 26
16	3	3	2369·918	227 36 35	2380·705	223 6 48
17	3	1	3211·763	270 46 36	3528·059	263 31 31
18	3	2	4796·276	259 16 9	4263·023	255 4 48
19	3	3	3954·919	240 6 58	2789·282	253 14 37
20	3	2	5719·491	283 45 15	6848·518	281 2 45
21	3	3	963·525	285 42 17	1745·713	298 23 20
22	3	2	4708·532	251 41 55	4843·676	248 12 41
23	3	1	3161·216	267 42 56	2120·031	261 56 20
24	3	1	3679·683	277 12 26	3388·578	272 36 47
25	3	2	4095·903	259 6 58	5085·403	252 26 28
26	3	2	5686·703	253 7 15	5493·288	256 0 56
27	3	1	4045·352	268 24 42	5097·784	276 46 35
28	3	3	5511·906	292 48 46	5327·954	302 24 6
29	3	1	5389·438	275 53 44	6008·341	273 10 11
30	3	2	4764·892	284 54 45	5239·097	283 7 28
31	3	1	5538·700	264 21 44	6949·113	270 16 35
32	3	1	6297·759	274 15 11	7062·612	265 40 51
33	3	2	6389·479	282 45 16	6349·276	287 32 53

Reduction of Heliometer Observations.

The approximate places of the stars for the epoch 1906·0 are quoted in Table I. With these approximate places, tabular distances and position-angles were computed. On comparing these tabular distances with the distances as derived from the heliometer measures we obtain relations between the corrections to the co-ordinates of the stars of the following form,—

$$S_a\sigma + (\Delta\alpha_2 - \Delta\alpha_1)\cos\delta_a \sin p_a + (\Delta\delta_2 - \Delta\delta_1)\cos p_a = O_a - C_a$$
$$S_b\sigma + (\Delta\alpha_3 - \Delta\alpha_2)\cos\delta_b \sin p_b + (\Delta\delta_3 - \Delta\delta_2)\cos p_b = O_b - C_b$$

where the suffixes 1, 2, 3 refer to the stars in increasing order of R.A., the suffixes a, b to the pairs 1–2, 2–3 respectively. S denotes the distance, σ a constant depending on the instrumental scale-value, δ the mean declination, and p the position-angle of a pair, and O, C respectively the observed and computed distances.

On eliminating σ we derive

$$(\Delta\alpha_2 - \Delta\alpha_1)\frac{\cos\delta_a \sin p_a}{S_a} - (\Delta\alpha_3 - \Delta\alpha_2)\frac{\cos\delta_b \sin p_b}{S_b}$$
$$+ (\Delta\delta_2 - \Delta\delta_1)\frac{\cos p_a}{S_a} - (\Delta\delta_3 - \Delta\delta_1)\frac{\cos p_b}{S_b} = \frac{O_a - C_a}{S_a} - \frac{O_b - C_b}{S_b} \quad . \; . \; . \quad \text{I.}$$

In like manner, from the observations of position-angle introducing a constant quantity π to denote the mean index correction to the position-circle during the several observations of a group, we form equations of condition as follows,—

$$S_a\pi + (\Delta\alpha_2 - \Delta\alpha_1)\cos\delta_a \cos p_a - (\Delta\delta_2 - \Delta\delta_1)\sin p_a = (O_a' - C_a')\sin S_a$$
$$S_b\pi + (\Delta\alpha_3 - \Delta\alpha_2)\cos\delta_b \cos p_b - (\Delta\delta_3 - \Delta\delta_2)\sin p_b = (O_b' - C_b')\sin S_b$$

and on elimination of π, S_a, S_b being expressed in seconds of arc

$$(\Delta\alpha_2 - \Delta\alpha_1)\frac{\cos\delta_a \cos p_a}{S_a} - (\Delta\alpha_3 - \Delta\alpha_2)\frac{\cos\delta_b \cos p_b}{S_b}$$
$$- (\Delta\delta_2 - \Delta\delta_1)\frac{\sin p_a}{S_a} + (\Delta\delta_3 - \Delta\delta_2)\frac{\sin p_b}{S_b} = (O_a' - C_a' - O_b' + C_b')\sin 1'' \quad . \; . \; . \quad \text{II.}$$

On eliminating $\Delta\delta_2$ from the equations I. and II. we obtain a linear relation between $\Delta\alpha_1$, $\Delta\alpha_2$, $\Delta\alpha_3$, $\Delta\delta_1 - \Delta\delta_3$. The algebraic elimination is cumbersome, but the numerical elimination is easily performed in special cases. This relation takes the form

$$\alpha(\Delta\alpha_2 - \Delta\alpha_1) - \beta(\Delta\alpha_3 - \Delta\alpha_2) = \gamma(\Delta\delta_1 - \Delta\delta_3) + n$$

where, if the stars selected are well chosen, we have approximately $\alpha = \beta$, while γ is small in comparison with either of them. In forming these equations such a factor has been introduced as to reduce the coefficient of $\Delta\alpha_2$ to unity, *i.e.* so that $\alpha + \beta = 1$.

The following are the equations of condition resulting in this manner from the heliometer measures :—

Equations of Condition resulting from Heliometer Measures.

Group.				
1	$0{\cdot}433(\Delta\alpha_2 - \Delta\alpha_1)$	$-0{\cdot}566(\Delta\alpha_3 - \Delta\alpha_2)$	$= +0{\cdot}065(\Delta\delta_1 - \Delta\delta_3)$	$+0''{\cdot}29$
2	0·508	−0·492	= −0·025	+0·53
3	0·455	−0·546	= −0·035	+0·33
4	0·487	−0·514	= −0·011	+0·25
5	0·493	−0·506	= −0·035	+0·17
6	0·468	−0·532	= −0·002	−0·43
7	0·503	−0·497	= 000	+0·42
8	0·541	−0·459	= +0·005	−0·03
9	0·507	−0·492	= +0·015	−0·04
10	0·547	−0·453	= −0·009	+0·63
11	0·519	−0·481	= −0·028	+0·44
12	0·482	−0·518	= −0·009	+0·70
13	0·499	−0·501	= +0·029	+0·65
14	0·529	−0·470	= +0·007	+1·07
15	0·527	−0·475	= −0·017	+0·23
16	0·501	−0·499	= −0·020	+0·11
17	0·524	−0·476	= −0·034	+0·85
18	0·470	−0·530	= −0·018	+0·10
19	0·412	−0·587	= +0·056	+0·96
20	0·545	−0·454	= −0·012	+0·49
21	0·647	−0·353	= +0·053	+0·01
22	0·507	−0·493	= −0·015	+0·01
23	0·401	−0·599	= −0·024	−0·44
24	0·480	−0·521	= −0·020	−0·09
25	0·553	−0·446	= −0·029	−0·30
26	0·491	−0·509	= +0·013	+0·29
27	0·559	−0·441	= +0·037	0·00
28	0·491	−0·509	= +0·043	+0·12
29	0·527	−0·473	= −0·013	−0·03
30	0·524	−0·475	= −0·008	+0·69
31	0·556	−0·443	= +0·026	+0·27
32	0·529	−0·471	= −0·038	+0·32
33	0·499	−0·501	= +0·020	+0·68

The quantities $\Delta\delta_1$, $\Delta\delta_3$ are retained in the right-hand members, as in a few cases the finally adopted values of the declinations differ from those quoted in Table I., which were derived from a few early observations only. The following are the corrections derived from the inclusion of additional observations of the declination with the Transit Circles :—

Group.	$\Delta\delta_1$	$\Delta\delta_3$
3	$-0''.38$	...
18	$-\ .39$	$-0''.51$
19	$-\ .06$	-1.05
20	$-\ .16$	$-\ .11$
21	$-\ .50$	$-\ .30$
28	...	$+\ .30$
32	$-\ .13$	$-\ .68$
33	...	$-\ .26$

In order to subject the magnitude personality to an analytical treatment, it was now assumed that each transit observation is affected by an error which may be expressed analytically by the formula

$$\alpha(m-4)+\beta(m-4)^2$$

where m denotes the magnitude of the star and α, β constants for the observer. The adopted magnitudes are those quoted in Table I.

Thus for any pair of stars of R.A. a_1, a_2, say of magnitudes m_1, m_2, the observed difference of R.A. may be equated to

$$a_2-a_1+\alpha(m_2-m_1)+\beta(m_2-m_1)(m_2+m_1-8)\,;$$

or if we denote this quantity by O and the tabular difference of R.A. as dependent on Table I. by C we find

$$\Delta a_2-\Delta a_1=\mathrm{O}-\mathrm{C}-\left[\alpha(m_2-m_1)+\beta(m_2-m_1)(m_2+m_1-8)\right]$$

On substituting these expressions in the left-hand members of the equations of condition resulting from the heliometer measures, we derive a series of linear equations for the determination of the quantities of α, β which may be expressed in the following tabular form. The suffixes attached to the absolute terms represent the number of meridian observations involved in each.

Group.	Coefficients of		Absolute terms for						
	α	β	Power.	Pead.	Wilkin.	Jeffries.	Mullis.	Wood.	Jackson.
			"	"	"	"	"	"	"
1	5.31	18.73	...	$+0.78_2$	-0.43_1	...	...	...	...
2	7.30	13.92	...	$+1.07_2$	$+0.39_2$	...	$+0.18_1$	...	...
3	3.61	18.02	...	$+1.08_3$	$+0.44_1$	...	...	$+0.78_1$	-0.41_1
4	5.07	12.50	$+0.34_2$	$+1.37_3$	$+0.78_2$	...	$+0.25_2$	...	$+0.08_1$
5	4.89	3.08	$+1.16_2$	$+0.91_4$	$+0.49_2$	...	-0.31_1	-0.16_1	-0.40_1
6	5.30	22.74	$+0.65_1$	$+1.08_3$	-0.02_2	$+0.36_1$	$+0.54_1$	-0.49_1	-0.49_1
7	5.41	24.14	...	$+1.28_5$	$+0.57_2$	$+1.18_1$	$+0.29_1$	...	-0.24_1
8	4.70	26.80	$+0.28_1$	$+1.17_4$	$+0.20_2$	...	$+0.07_1$	...	-0.53_1
9	5.40	23.25	$+0.66_3$	$+1.08_6$	$+0.18_4$	0.00_2	-0.56_1	...	$+0.04_2$
10	5.03	19.84	$+0.10_4$	$+0.66_3$	...	...	...	...	...
11	3.72	9.92	$+0.27_4$	$+1.25_7$	$+0.29_3$	$+0.09_2$	$+0.54_3$	$+0.07_1$	$+0.04_3$
12	3.85	12.45	$+0.20_2$	$+0.82_5$	...	...	...	...	...
13	7.30	7.35	$+0.80_6$	$+1.07_5$	$+0.80_1$	$+0.19_1$	-0.41_2	-0.19_2	$+0.81_1$
14	7.82	12.06	$+1.05_4$	$+1.42_5$	...	...	...	...	...
15	4.74	16.50	$+0.61_4$	$+0.33_4$	$+0.08_1$	$+0.44_3$	$+0.34_2$	$+0.10_1$	-0.19_3
16	4.35	13.55	-0.19_4	-0.10_4	...	...	...	...	...
17	3.30	18.34	-0.13_4	$+0.24_3$	-0.12_1	$+0.70_8$	$+0.03_2$	$+0.62_3$	$+0.55_3$
18	3.67	17.42	$+0.66_4$	$+0.69_3$	...	$+0.50_4$	$+0.02_3$	$+0.08_3$	$+0.27_2$
19	3.39	15.10	$+0.72_4$	$+1.02_3$	...	...	...	...	...
20	4.19	18.48	$+0.23_1$	$+0.14_1$	$+0.55_1$	-0.43_2	$+0.20_3$	$+0.20_5$	-0.30_2
21	2.93	9.82	$+0.24_4$	$+0.29_3$	...	...	...	...	...
22	5.01	15.13	$+0.13_5$	-0.27_1	$+0.33_1$	$+0.10_4$	-0.29_2	$+0.15_6$	-0.03_3
23	5.83	22.40	-0.18_5	$+0.28_1$	...	...	...	...	...
24	6.20	21.68	$+0.44_4$	$+1.03_1$	$+0.35_1$	$+0.40_3$	-0.21_2	-0.26_3	$+0.21_2$
25	4.35	16.31	-0.29_3	$+0.54_1$	$+0.30_2$	-0.21_3	$+0.28_3$	$+0.10_4$	-0.23_4
26	3.71	19.67	$+0.75_2$	...	$+0.06_1$	$+0.42_2$	$+0.11_2$	-0.03_3	$+0.25_3$
27	4.38	22.56	$+0.25_1$	$+1.14_1$	-0.11_1	$+0.10_1$	$+0.49_1$	-0.17_2	-0.23_3
28	5.84	17.60	-0.09_2	...	$+0.13_2$	-0.23_1	$+0.66_2$	-0.11_3	...
29	4.45	22.47	-0.19_1	$+1.33_1$	$+0.03_2$	$+0.48_1$	-0.22_3	-0.10_3	$+0.37_3$
30	4.14	21.71	-1.89_1	$+1.13_1$	-0.05_2	$+1.01_1$	$+0.49_3$	-0.15_3	$+0.78_3$
31	4.18	17.26	$+0.76_1$	$+2.01_1$	$+0.16_2$	-0.09_1	$+0.79_3$	-0.05_3	$+0.21_3$
32	4.57	18.18	$+2.08_1$	...	-0.20_1	...	$+0.07_3$	$+0.31_3$	$+0.24_2$
33	6.40	19.55	...	...	$+0.76_2$	$+0.31_1$	$+1.02_3$	$+0.33_3$	$+0.40_1$

For the purpose of combining these equations, it was assumed that the errors in the absolute terms resulting from the heliometer measures were insignificant compared with those resulting from the transit observations, and the equations were accordingly weighted according to the number of separate observations of each group

obtained by the meridian circle observers. A least square solution then led to the following results:—

Observer.	α.		β.		Probable error of	
	In arc.	In time.	In arc.	In time.	α.	β.
	″	s	″	s	s	s
Power .	+0·134	+0·0089	−0·020	−0·0013	±0·0020	±0·0006
Pead .	+ ·148	+ ·0099	+ ·011	+ ·0007	± ·0016	± ·0005
Wilkin .	+ ·117	+ ·0078	− ·018	− ·0012	± ·0012	± ·0003
Jeffries .	− ·053	− ·0035	+ ·028	+ ·0019	± ·0027	± ·0007
Mullis .	+ ·011	+ ·0007	+ ·010	+ ·0007	± ·0023	± ·0006
Wood .	− ·015	− ·0010	+ ·006	+ ·0004	± ·0016	± ·0004
Jackson .	− ·003	− ·0002	+ ·006	+ ·0004	± ·0025	± ·0006

The resulting corrections to the observations to make all correspond with those of stars of the fourth magnitude are as follows:—

Correction for Personal Equation in R.A. depending on Magnitude.

Mag.	Power.	Pead.	Wilkin.	Jeffries.	Mullis.	Wood.	Jackson.
	s	s	s	s	s	s	s
0	+0·057	+0·029	+0·050	−0·044	−0·007	−0·010	−0·007
1	38	24	34	27	− 4	7	− 4
2	23	17	21	14	− 1	4	− 2
3	+ ·010	+ ·009	+ ·009	− ·005	000	− ·001	− ·001
4	...	...	...	...	...	..	...
5	− ·008	− ·011	− ·007	+ ·002	− ·002	− ·001	000
6	− 13	23	11	000	− 4	000	− ·001
7	− 16	36	12	− ·006	− 8	− ·001	− ·003
8	− 15	51	12	− 16	− 13	− ·002	− ·006
9	− 14	− ·068	− ·009	− ·029	− 20	− ·005	− ·009

The quantities thus derived in the case of the observers who used the travelling wire method appear to be quite insignificant except at the extreme limits of magnitude involved in the table. The strength of the determination at these limits depends, however, not so much on the actual weight derived directly from the observations, as on the weight artificially extended to it by the assumption that the magnitude personality may be expressed by the formula $\alpha m + \beta m^2$.

The use of such a formula can only be justified as a convenient means of interpolation over the range of magnitude covered by the stars actually observed. If we limit ourselves to the range 3 − 8, within which limits the majority of the stars are contained, we may safely conclude that the observations dealt with give no evidence of the existence of sensible personality depending on magnitude. Beyond these limits the quantities are not larger than might reasonably be expected to arise from the use of an

empirical 'extrapolation' formula, which will have the effect of magnifying the accidental errors of observation at the extremities of the table.

The results for the observers with the old Transit Circle from observations made partly through screens in 1900 and 1904 are as follows:—

Mag.	Power.	Pead.
	s	s
0	+0·008	+0·037
1	7	28
2	5	18
3	+0·003	+ ·009
4	...	...
5	− ·004	− ·009
6	− 9	− ·018
7	− 15	− ·026
8	− 21	− ·034
9	− 28	− ·042

The agreement with the present results is as close as could be expected, except in the case of the brighter stars for Power and the fainter stars for Pead. The discordances are doubtless due to the inadequacy of the material employed to correctly determine the magnitude personality at these extreme limits of magnitude, rather than to any real change in the observer's habits during the interval between the two sets of observations.

The plan of these observations was prepared by Sir David Gill, and the observations were well advanced before his departure from the Cape. The observations were completed and the computations made and prepared for press in their present form under the direction of Mr S. S. Hough.

On the Value of the Solar Parallax resulting from the Greenwich Photographs of Eros, 1900–1901.

(*Communicated by the Astronomer Royal.*)

The discussion of the photographs of Eros taken at Greenwich during the opposition of 1900–1901 has now been completed, and a value of the solar parallax has been deduced as resulting from the photographs taken at Greenwich. The plan of the Eros Commission contemplated, ultimately, the combined discussion of the photographs taken at all the co-operating observatories, but there is obviously great difficulty in treating such a mass of heterogeneous material, and it seems desirable, in the first instance, to discuss separately the observations of the individual observatories, and deduce a value of the solar parallax in each case.